



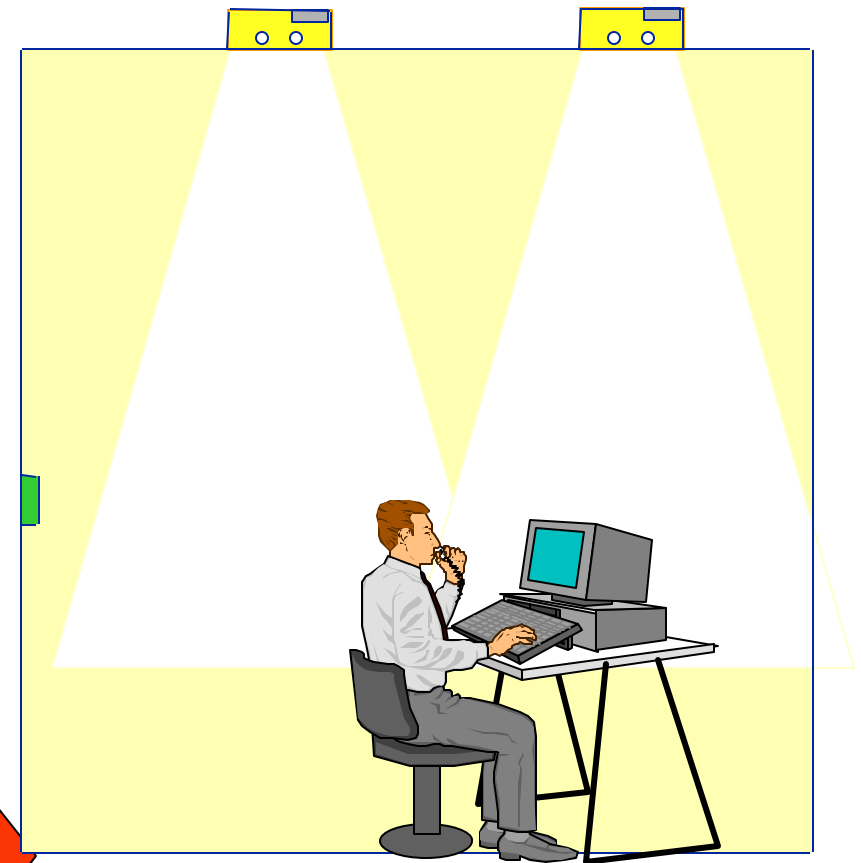
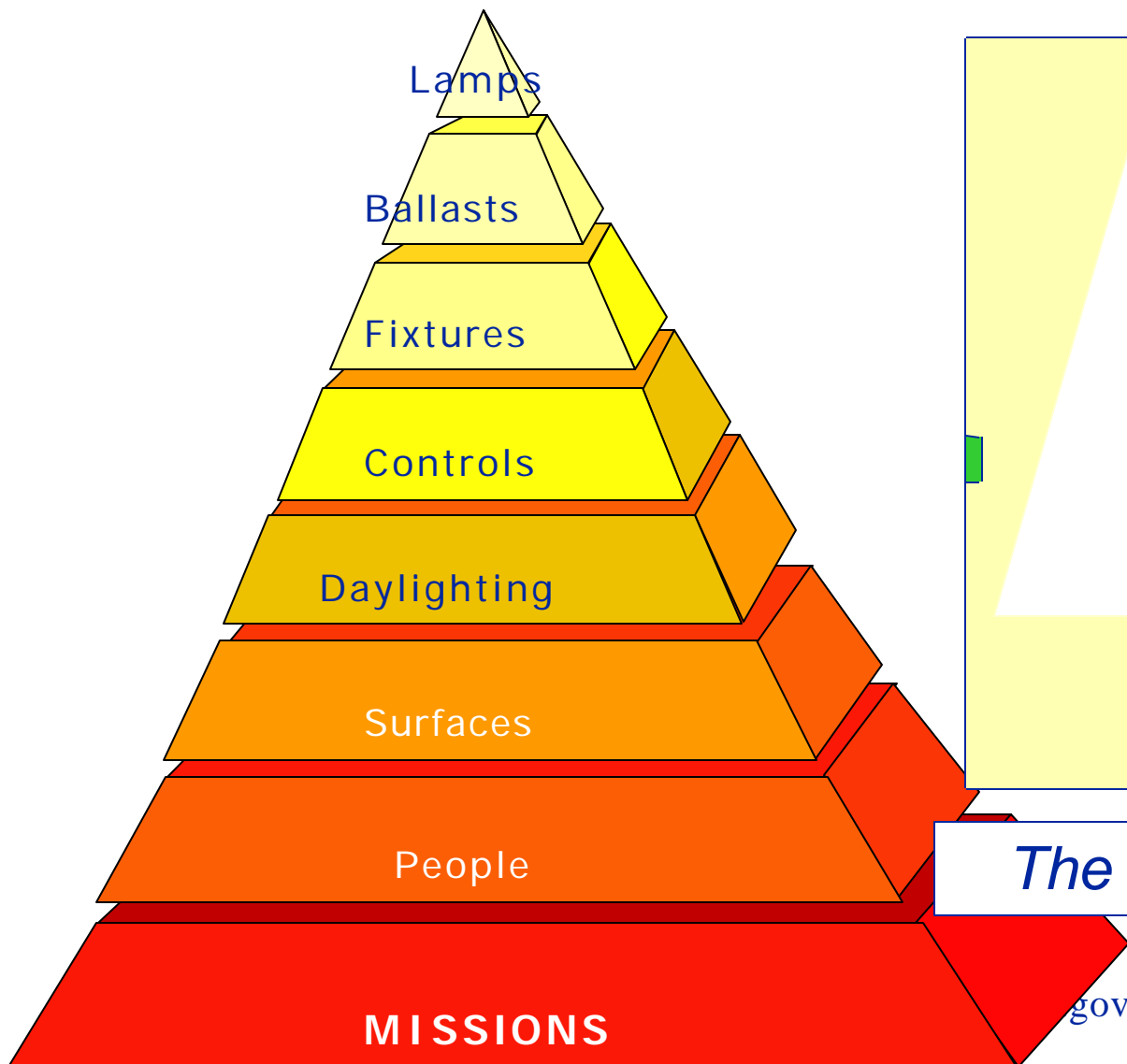
An Energy Efficiency Workshop & Exposition
Kansas City, Missouri

Benefits of Energy Effective Lighting

Carol Jones, LC
Pacific Northwest National Laboratory



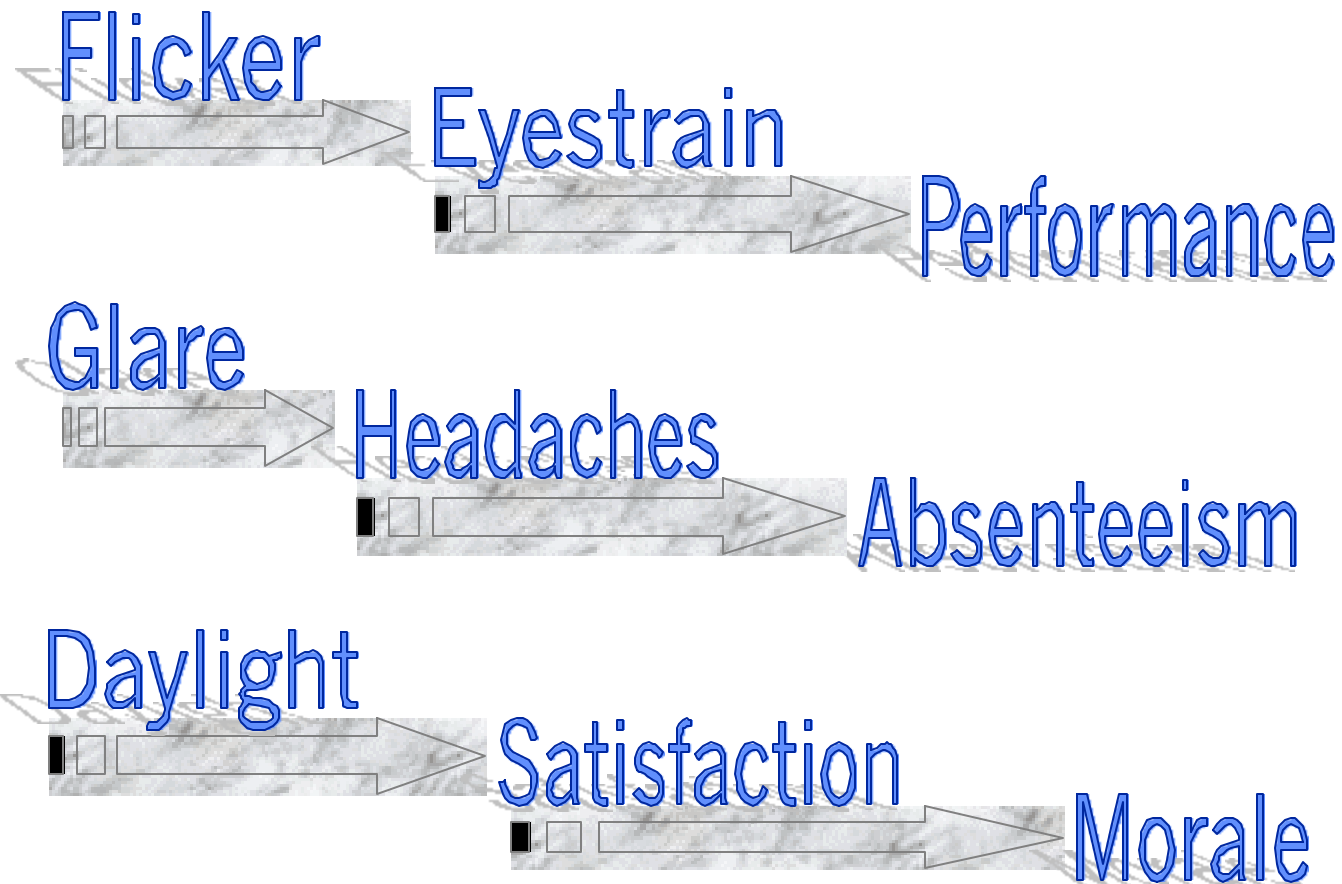
Lighting > People > Missions



The Lighted Environment



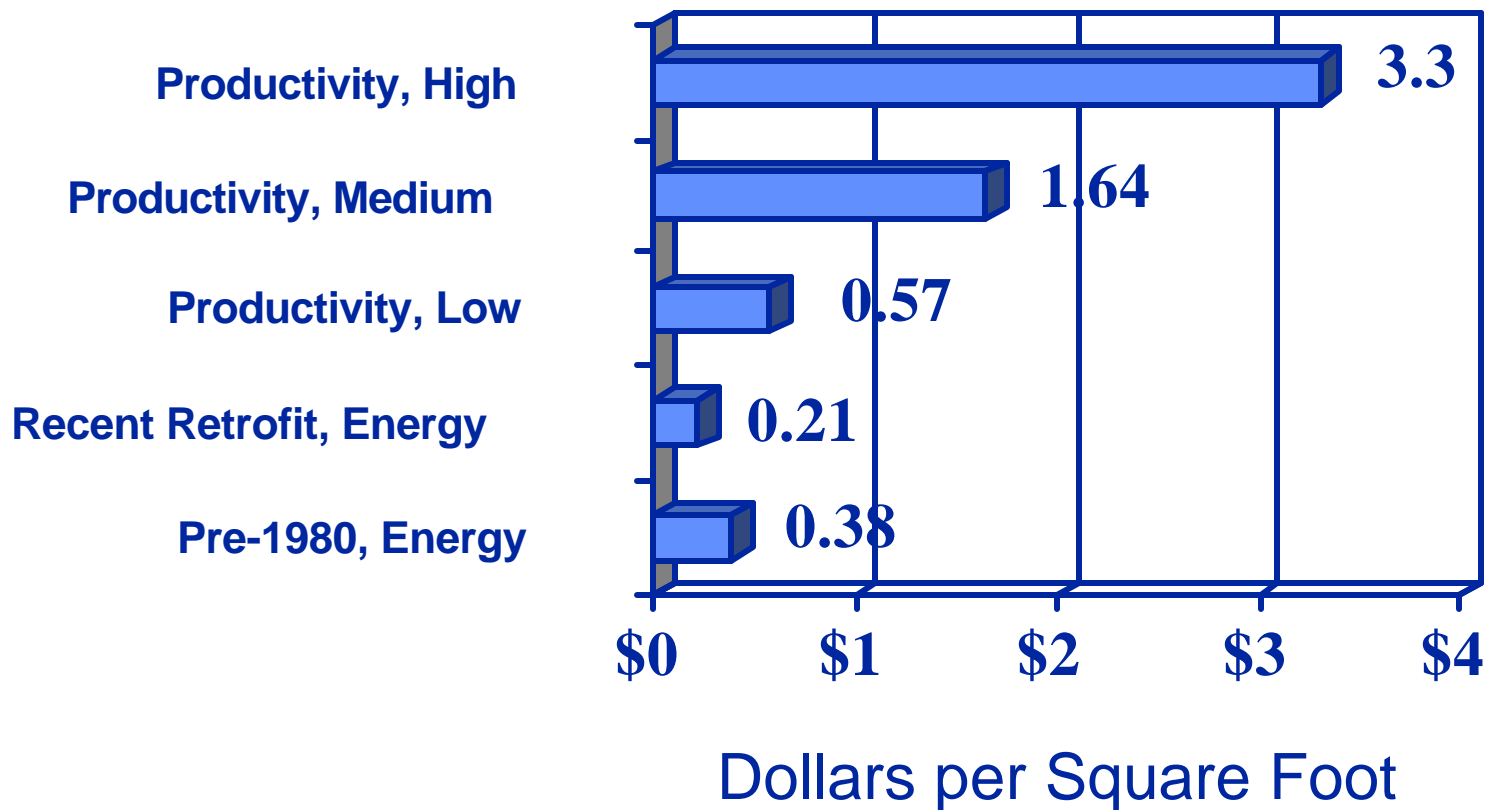
How can lighting affect us?





The value of lighting in Federal productivity

Comparison of Energy & Productivity Costs





Energy cost vs. Productivity cost

- Federal office lighting energy use:
 - ~\$17 million per year
- Federal office worker employee costs:
 - ~\$70 billion per year (400 times the lighting energy cost!)

These overall numbers give you a sense of the magnitude of the difference between employee costs and lighting energy costs. Including state and local governments would quadruple the potential impact



Concept of Energy Effective Lighting

- There should be additional benefits arising out of the implementation of the presidential executive orders.
- This provides significant **incentive** for efficiency projects that include relighting. In addition to the environmental and cost benefits of energy savings, it becomes possible to improve the workplace for Federal workers, resulting in increased satisfaction and performance.
- All reasonable effort should be made to provide Energy Effective Lighting using Federal life cycle cost guidelines.



Benefits are possible IF ...

- Potential productivity improvements are possible ***if*** the relighting is an improvement to the quality of the lighted environment.
- Energy efficient lighting can also be energy *effective*, but only if thoughtful and careful decisions are made.



Proven Opportunities

*The **theory** behind improving productivity with quality lighting is based on the fact that lighting has a direct and powerful impact on the occupants of buildings. From a conceptual perspective it is easy to understand that lighting affects us in many ways, both physically and psychologically. However, many energy managers struggle to separate the **anecdotal** stories about such benefits from reliable and **proven** opportunities. This presentation and flyer provides specific information from actual research studies, with simple guidance on steps to take in your project work.*



What do we really know?

- We don't have the magic number (% productivity improved).
- We are working towards that quantification (Andover project, Light Right Consortium)
- We DO have many pieces of the puzzle, and “mini-quantifications”
- What should we be doing to receive additional benefits?

Room Surface Brightness

- Satisfaction increases when there is high overall brightness of the room surfaces.
- High contrast conditions in office environments are consistently rated poorly.



Room Surface Brightness

- Dissatisfaction with dark walls may result from perceptions of gloominess.
- Gloomy environments are a common problem when using parabolic fixtures- take care to put light on the walls!





Room Surface Brightness

- Dissatisfaction with dark walls may result from perceptions of gloominess. Psychologically undesirable, reduced peripheral vision, primitive warning system.
- Wall washers and sconces add visual interest and increase ratings of lighting quality.
- The nature of the task makes a difference.
- Concept of Volumetric brightness is being investigated further (IES QVE).

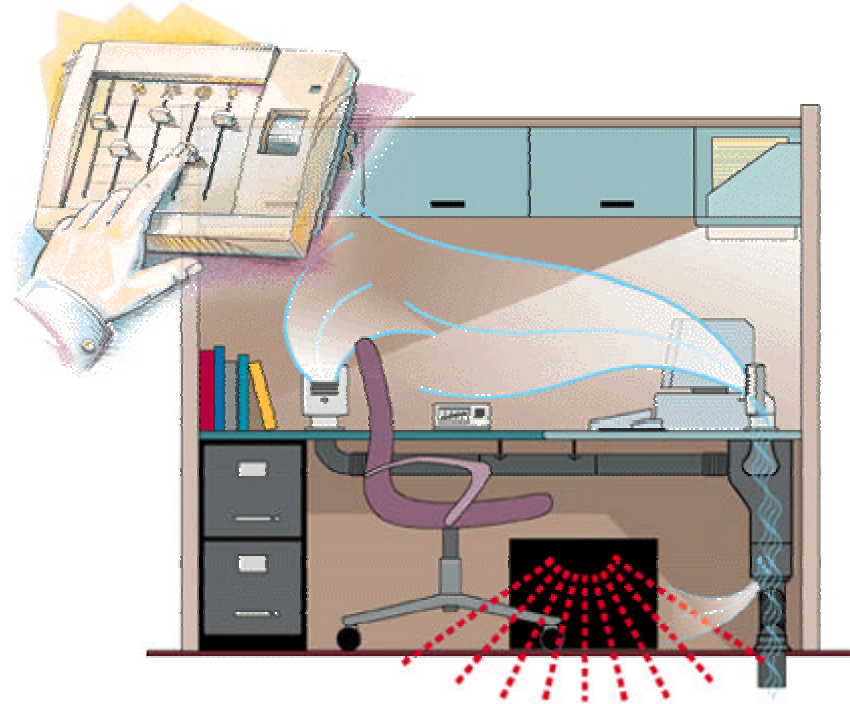
Quality Daylighting

- It's widely understood that most people prefer daylighting and access to a view.
- ***Quality*** daylighting is important. Beware of glare and thermal factors.
- See the new Advanced Lighting Guidelines for more information.



Personal Control

- o Positive psychological impact on workers; created a greater sense of control throughout the day



Personal Environments, graphic courtesy of
Johnson Controls, Inc.



Personal Control

- When dimmable ceiling lighting was given to subjects it was well-used with positive results
 - More satisfied with the lighting, rated it as higher quality
 - Felt more comfortable in the room
 - Rated the tasks as less difficult
 - 35-42% decrease in electrical consumption
 - Individuals vary enormously in preferred lighting. Results of one study- only 40% of population within 5 fc of desired level.

Reduced Flicker

- Researchers have found that headaches are reduced and task performance increases when electronic ballasts are used rather than magnetic.





Lighting and Mood

- Over the past decade research has shown that subjects who experience positive moods solve problems more quickly and come up with more creative solutions than subjects in either neutral or negative moods.
- More study is necessary, but to the extent that lighting impacts mood, it ***may*** be influential in problem solving and creativity.

Overhead Glare

- Brand new research validates IES QVE work showing that bright lamps and reflectors are unacceptable in open direct fixtures over workstations.
- This is important new information, with significant implications.



“If you feel the need to wear a baseball cap in your office you have a lighting quality problem.”

--Naomi Miller, Chair, IESNA Quality of the Visual Environment Committee

Reflected Glare

- Most of us are familiar with reflected glare problems. Lensed fixtures tend to be the worst offenders. We recommend relighting wherever possible.
- New research shows what we all know, that improved screens make a big difference. The quality of the screens and the orientation of the workstation are the best ways to deal with this issue if fixtures cannot be replaced. (RP-1)





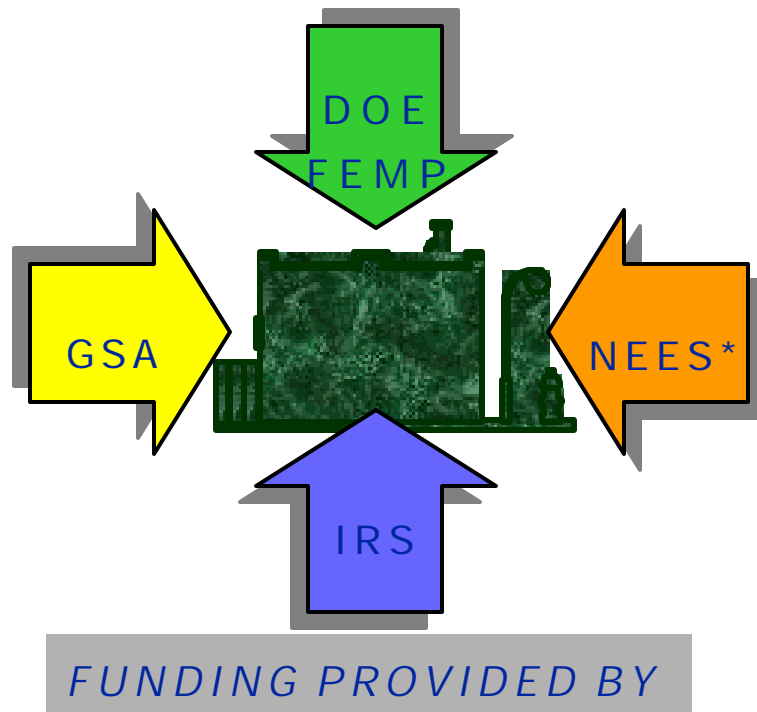
We want to know more

- Two exciting new projects are underway which seek to measure the impact of lighting on people.
 - IRS Building in Andover, MA.
 - Light Right Consortium project (private/public partnership).



Andover Project

- Lighting Quality & Productivity Project- Andover, MA
 - Testing the impact of different lighting systems on performance, comfort, and satisfaction



- *Internal Revenue Service*
 - Interest in modernizing Andover and other facilities to focus on improved service.
- *Government Services Administration*
 - Interest in providing great work environments to all federal agencies.
- *Department of Energy, FEMP Lights*
 - Promotes energy programs to meet the present and future needs of the federal community.
- *New England Electric Systems (NEES)*
 - Local utility organization support
- *Lighting Industry*
 - lamp, ballast, luminaire manufacturers



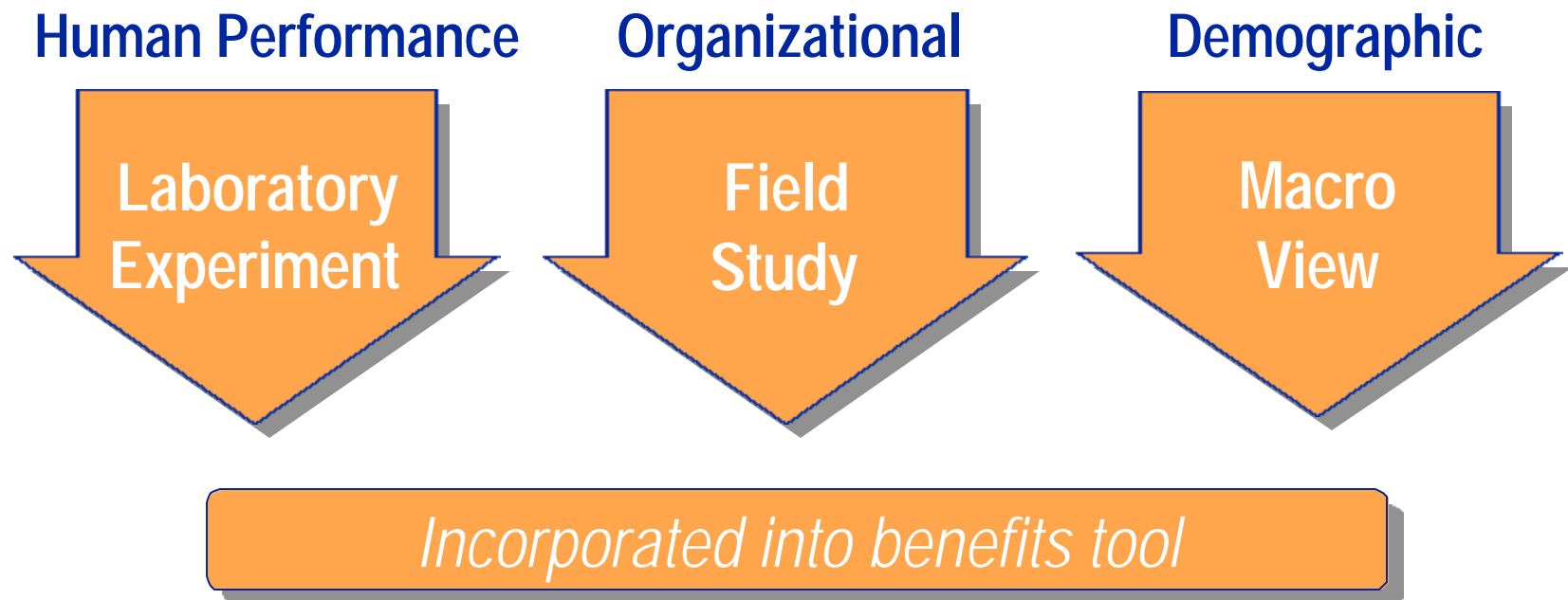
Light Right Consortium

- Research projects inside of a market transformation vehicle
- A model which is market- and impact-driven
- A collaborative process ensuring scientific excellence, broad buy-in, and maximum market impact
- A PR & deployment element which will bring unprecedented visibility to lighting as an ergonomic issue.



Phase Two Research Model

*Three study tracks will feed into the
Benefits Analysis Tool*





Light Right Research

- Research topics are non-task room surface brightness and personal control.
- Studying 4 designs--including some that are similar to systems that you'll hear about in a few minutes...
- www.lightright.org



Use lighting to your advantage

IF your lighting is
EFFECTIVE you can:

- Support your mission
- Improve your facility
- Reduce complaints
- Improve occupant comfort & productivity

AND

- Achieve deep energy savings with whole building ECMs



*LIGHTING CAN BE A
MEANS TO AN END*